
**Powered industrial trucks and
tractors — Brake performance and
component strength**

*Chariots de manutention et tracteurs industriels automoteurs —
Performance de freinage et résistance des éléments de frein*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 110, *Industrial trucks*, Subcommittee SC 2, *Safety of powered industrial trucks*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

This third edition cancels and replaces the second edition (ISO 6292:2008), which has been technically revised.

The main changes compared to the previous edition are as follows:

- the definition for drawbar drag has been added as [3.13](#);
- [Subclause 4.7](#) (previously 4.8) has been technically revised;
- for service brake systems, the heat fade test is now compulsory in all test methods.
- the scope has been extended to industrial tractors with 66 750 N drawbar pull.

Introduction

Industrial trucks, generally referred to as trucks, can satisfy the braking system requirements of this document by complying with either the stopping distance requirements or the drawbar drag requirements. Based on the requirements for brakes of rubber-tired earthmoving machinery (ISO 3450), the stopping distance as a measurement value has been established. The brake performance is limited by consideration of the load. For further reference as to how the measurement of stopping distance and measurement of brake reaction time were derived, see ISO/TR 29944.

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Powered industrial trucks and tractors — Brake performance and component strength

1 Scope

This document specifies performance, test methods, controls, control forces and component strength for brake systems fitted to the following, as defined in ISO 5053-1:

- powered industrial trucks of all capacities;
- towing and pushing tractors up to and including 66 750 N drawbar pull (hereafter referred to as industrial tractors);
- burden carriers; and
- industrial trucks handling freight containers.

Loss of electrical power and loss of any other form of power assistance is not covered by this document. Braking systems used in emergency situations (e.g. activating the emergency switch or control system shut down) are not covered in this document.

This document only includes requirements for newly manufactured trucks.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 braking force

force at the contact surface between a wheel and the ground, produced by the effect of a *braking system* (3.3), which opposes the speed or the tendency to movement of the truck

[SOURCE: ISO 611:2003, 9.11.3]

3.2 braking performance

performance of a *braking system* (3.3) as measured by the braking distance in relation to the initial speed of the truck and/or by *braking force* (3.1) and the capability to hold the truck at a standstill on a gradient

3.3 braking system

combination of parts which fulfil one or more of the following functions:

- control (usually to reduce) a truck's speed;

— bring the truck to a halt or hold it stationary

[SOURCE: ISO 611:2003, 3.2, modified — In the definition, the word "vehicle" has been changed to "truck".]

3.4 cold brake

brake that meets one of the following conditions:

- a) the temperature measured at the periphery of the disc or on the outside of the drum is below 100 °C;
- b) in the case of totally enclosed brakes including oil-immersed brakes, the temperature on the outside of the housing is below 50 °C or within the manufacturer's specification;
- c) the brake has not been operated in the previous 1 h

3.5 fade test

<lining effectiveness> test procedure consisting of one or more brake applications or the continuous dragging of the brake to generate heat with the effect that differences in *braking performance* (3.2), if any, can be observed

[SOURCE: ISO 611:2003, 8.4]

3.6 lining burnishing

pre-test conditioning procedure for obtaining a specified degree of geometric, physical and chemical adaptation between the brake lining surface and the drum or disc

3.7 laden mass

foreseen maximum laden truck mass likely to occur in the intended use of the truck, taking into account various combinations of optional equipment and the actual capacity applicable at the lift height specified for the tests (where relevant)

3.8 parking braking system

braking system (3.3) allowing a truck to be held stationary mechanically, even on an inclined surface, particularly in the absence of the operator

3.9 service braking system

braking system (3.3) allowing the operator to control, directly or indirectly, the speed of the truck or to bring the truck to a halt

3.10 stopping distance

s_0
distance travelled by the truck during the total braking time, i.e. distance travelled by the truck from the instant when the driver begins to actuate the control device until the instant when the truck stops

Note 1 to entry: Control device is part of the *braking system* (3.3) which initiates its operation. Control devices of industrial trucks are defined in ISO 3691-1:2011, 4.4.2.2, 4.4.2.3 and 4.4.2.4.

3.11 test speed

speed greater than 90 % of the maximum designed truck speed

Note 1 to entry: If the truck speed is automatically reduced in certain load conditions or load positions (i.e. lift height dependent), this reduced speed is the maximum travel speed for that load condition/position.

3.12**unladen mass**

foreseen minimum unladen truck mass likely to occur in the intended use of the truck, taking into account various combinations of optional equipment

3.13**drawbar drag**

steady state *braking force* (3.1) that can be applied to the ground by a mechanical *braking system* (3.3) at a given speed

4 Requirements**4.1 Required brake systems**

The truck shall have the following brake systems:

- a service brake system;
- a parking brake system.

4.2 Operating means

The service and parking brakes shall be operated by means of independent systems. Both braking systems may utilize the same brakes; i.e. brake shoes, brake drums and related actuating items. Independent brake systems are not required to be fitted to stand-on and pedestrian controlled trucks as defined in ISO 3691-1.

4.3 Service braking system

All trucks shall meet the service brake requirements for:

- stopping distance (6.3.1) and heat fade test (6.5.2);
- drawbar drag test (6.3.2) and heat fade test (6.5.3); or
- alternative test procedure (6.3.3), e.g. calculation, and heat fade test simulation (6.5).

4.4 Parking braking system

The parking braking system shall meet the requirements of 6.2.

4.5 Brake control forces

4.5.1 The control forces to meet the required brake performances for the systems, as specified in 6.2 and either 6.3.1 or 6.3.2, shall not exceed the values given in 4.5.2 to 4.5.6 and summarized in Table 1.

NOTE Other types of brake actuations are possible.

4.5.2 For brakes applied by depressing a pedal, the required service brake performance and parking brake performance shall be attained with a pedal force not greater than 450 N.

4.5.3 For brakes applied by an upward movement of a brake pedal (releasing the brake pedal), the required service brake performance and parking brake performance specified shall be attained with the pedal fully released. The force required to release the brakes and to hold the pedal fully depressed while travelling shall not be greater than 200 N.

4.5.4 For parking brakes applied by means of a hand lever, the required brake performance shall be attained when a force not greater than 300 N is applied to the hand lever at the gripping point.

4.5.5 For service brakes applied by squeezing a handgrip, the required brake performance shall be attained when a force not greater than 150 N is applied to the handgrip at the gripping point.

4.5.6 For brakes applied by means of a tiller which is biased, e.g. spring loaded, to the upright position (as on pedestrian controlled trucks), the required service brake performance shall be attained at the maximum depressed stroke position of the tiller when a force not greater than 150 N is applied at the mid-point of the handgrip.

4.6 Brake component strength

4.6.1 The strength of brake components shall not be lower than the values given in [4.6.2](#) to [4.6.6](#) and summarized in [Table 1](#).

4.6.2 For trucks having a downward movement of a brake pedal (depressing the brake pedal) to apply the service or parking brake(s), the system shall be capable of withstanding a brake pedal force of at least 1 200 N without any failure, cracking or deformation which affects the brake performance or function.

4.6.3 For trucks having an upward movement of a brake pedal (releasing the brake pedal) to apply the service or parking brake(s), the system shall be capable of withstanding a force of 200 % of the maximum possible setting of the spring which applies the brake(s) without any failure or cracking or any deformation which affects the brake performance or function.

The pedal when fully depressed, and its associated mechanical stop shall be capable of withstanding a force of 1 800 N applied at the centre of the brake pedal actuating surface without any failure, cracking or deformation which affects the brake performance or function.

4.6.4 For trucks having a hand lever to apply the parking brake(s), the system shall be capable of withstanding a force of at least 600 N applied at the gripping point of the lever, without any failure, cracking or deformation which affects the brake performance or function.

4.6.5 For trucks having a handgrip which is squeezed to apply the service brake(s), the system shall be capable of withstanding a force of at least 300 N applied to the handgrip, without any failure, cracking or deformation which affects the brake performance or function.

4.6.6 For trucks having a tiller which is depressed or released to apply the service or parking brake(s), the system and associated mechanical stops shall be capable of withstanding a force of at least 900 N applied at the midpoint of the handgrip, without any failure, cracking or deformation which affects the brake performance or function.

Table 1 — Brake control forces and component strengths (in Newtons)

Brake type	Service brake		Parking brake	
	Maximum control force	Minimum component strength	Maximum control force	Minimum component strength
Depressed pedal	450	1 200	450	1 200
Released pedal	200	Up-stop 200 % maximum spring setting and Down stop 1 800 ^a	200	Up-stop 200 % maximum spring setting and Down stop 1 800 ^a
Hand lever	—	—	300 ^b	600
Squeeze handgrip	150	300	—	—
Tiller	150	900	—	900
^a See 4.6.3.				
^b See 6.2.2, last paragraph.				

4.7 Stored energy systems

4.7.1 Service brake recovery capacity

4.7.1.1 Air operating service braking system employing stored energy

The air operating service braking system shall have the capability of delivering 70 % of maximum system pressure measured at the brakes when the service brake is fully applied 20 times at the rate of 6 applications per minute with the truck stationary and the engine running at the optimum speed for braking energy recovery.

4.7.1.2 Braking systems with hydraulic accumulator

The capacity of hydraulic accumulator charging system shall be designed so that the pressure in the accumulator is not less than that required to meet the braking performance of either 6.3.1 or 6.3.2, when the service brake is fully applied with a frequency of one brake application every 5 seconds. For internal combustion engine trucks (IC), the test shall be performed at idle speed with the truck stationary. The test duration shall be at least 2 minutes.

4.7.2 Warning device for loss of stored energy

A service brake system employing stored energy shall be equipped with a warning device, which is activated before the stored energy reaches the level at which the truck cannot meet the required braking performance as specified in 6.3. The device shall be clearly visible or audible to the operator and provide a continuous warning when activated. Gauges indicating pressure or vacuum do not meet these requirements.

The warning device pressure level shall be set for activation at a pressure level such that the truck meets the requirements of either 6.3.1 or 6.3.2. This requirement is not applicable for hydraulic service braking systems which are redundant by other means, e.g. dual circuit braking systems.

The truck shall have enough stored energy to meet the requirements of 6.3.1 after the alarm occurs.

Truck speed can be automatically restricted while the alarm is triggered.